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SUMMARIZATION OF GAS BUBBLE TRAUMA MONITORING IN THE CLEARWATER RIVER, IDAHO

Final Report 1995 - 1999

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SUMMARIZATION OF GAS BUBBLE TRAUMA MONITORING IN THE CLEARWATER RIVER, IDAHO, 1995-1999.

A Report to Bonneville Power Administration
Contract 97BI31259

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INTRODUCTION

Beginning in 1995, the National Marine Fisheries Service (NMFS) requested periods of flow augmentation from Dworshak Dam and Reservoir for listed Snake River chinook salmon in the lower Clearwater River and Snake River. During these summer time discharge releases, flows were expected to exceed 15,000 cfs. Consequent to these high discharges, total dissolved gas (TDG) levels were expected to exceed water quality standards (110%) established by the Idaho Division of Environmental Quality (IDEQ). The NMFS requested a variance from the standard to allow the spill program that could result in TDG levels up to 120% saturation. This activity has been authorized by the IDEQ on an annual basis since 1995. A requirement imposed with the waiver was a monitoring program for the fish populations in the affected waters to determine extent of gas bubble trauma (GBT) associated with TDG equal to or greater than 110%.

The emphasis of the project was to address extent of GBT on resident fish species. Anadromous fish species (steelhead trout *Oncorhynchus mykiss*, chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch* and Pacific lamprey *Lampetra tridentata*) are also in the Clearwater River corridor during the time of flow augmentation.

STUDY AREA

The area monitored included 1.5 miles of the North Fork Clearwater River from Dworshak Dam downstream to its confluence with the Clearwater River (Figure 1) and 41 miles of the Clearwater River downstream of the N.F. Clearwater River to the Snake River at Lewiston. The study area was originally segmented into five study sections:

Section 1 – the 1.5 miles of the North Fork Clearwater River between Dworshak Dam and it confluence with the Clearwater River,
Section 2 – the 12 miles of the Clearwater River from the confluence with the N.F. Clearwater River downstream to the Lenore Bridge,
Section 3 –The 14 miles of Clearwater River from the Lenore Bridge downstream to the Potlatch River,
Section 4 – The 13 miles of Clearwater River from the Potlatch River downstream to Memorial Bridge at Lewiston,
Section 5 – The two miles of the Clearwater River from the Memorial Bridge to the Snake River.

Because section 5 consisted of primarily slack water of Lower Granite Pool, this section was not sampled after 1997.

METHODS

Sampling for GBT was conducted from about April 15 to August 15 of each year. Specific procedures are described in any of the annual reports listed in the bibliography. This report is a summarization of the five years of sampling.

RESULTS

Over the course of the past five years, over 30,000 individual fish were examined for GBT (Table 1). Not included in this total were the anadromous fish juveniles released immediately upon capture. Some hatchery and wild steelhead trout juveniles were incidentally captured and examined for GBT. Also not included in percentages of affected individual fish were kokanee salmon *Oncorhynchus nerka* and hatchery rainbow trout that were suspected of moving into the study area out of Dworshak Reservoir. There are no kokanee salmon residing in the river system below Dworshak Reservoir and are present as a result of being flushed through the dam during period of elevated discharges. Similarly, hatchery rainbow trout planted in Dworshak Reservoir are flushed into the study area during the same events. These fish are distinguishable as no similar hatchery trout are planted in the river system below the dam.

Considering all individuals fish examined, the incidence of gas bubble trauma was never greater than 1.0% in any given year (1997) (Table 1) and over 95% of incidences were found in sections 1 and 2 nearest Dworshak Dam (Tables 2-5). From a single species perspective, wild rainbow trout showed the highest incidence of GBT in 1996 and 1997, 4.5% and 9.4% respectively. The highest incidence of GBT for both an individual species and all species collectively occurred in 1997 when the greatest number of days exceeding the 110% and 120% TDG level occurred (Tables 6-10). Seventy-three percent of the fish exhibiting GBT were at the lowest level 1 ranking. With the exception of a single level 4 observation in 1999, all other fish with ranking greater than level 1, were found during 1997 when TDG levels were the highest.

The water quality standard for TDG (110%) is exceeded generally during two intervals. The initial event occurs during the spring or early summer timeframe as upstream snow melt results in discharges in excess of 15,000 cfs, generally an uncontrollable event. The second event occurs during late summer as discharges are increased to provide flow augmentation for outmigrating juvenile chinook salmon. Fifty-three percent of GBT was observed during the latter interval.

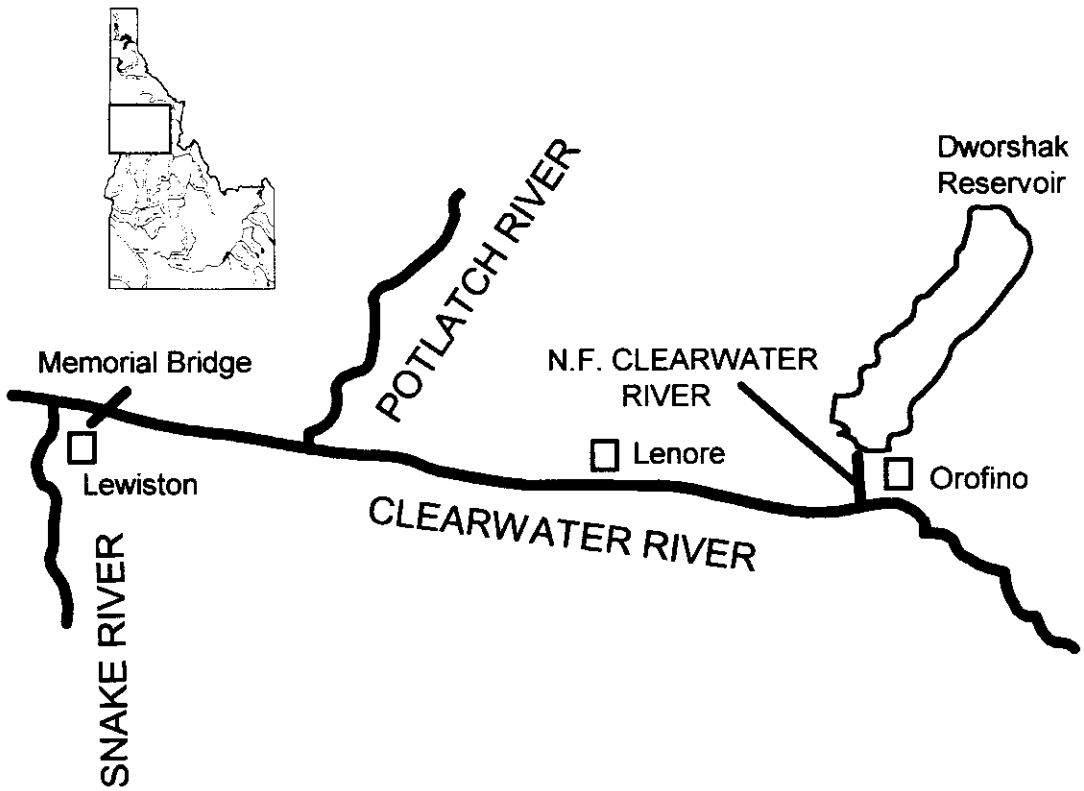

Figure 1. Location of gas bubble trauma sampling areas on the Clearwater River and the North Fork Clearwater River, ID.

DISCUSSION

High (>110%) TDG are associated with elevated incidences of gas bubble trauma in certain species of fish. Of the twenty species of fish sampled during the five-year period, GBT was observed in individuals of seven species, predominantly rainbow trout, mountain whitefish *Prosopium williamsoni* and largescale sucker *Catostomus macrocheilus*. Largescale sucker and mountain whitefish are the most abundant fish found in the river.

SUMMARY

1. Gas bubble trauma is associated with total dissolved gas levels greater than 110% and increases with saturation levels approaching 120%, and for extended periods of time.
2. The incidence of gas bubble trauma decreases with increased distance from Dworshak Dam as total dissolved gas levels dissipate as released water mixes with Clearwater River flow.
3. Wild rainbow trout exhibited greatest percentage of gas bubble trauma during high flow events in 1997.
4. A majority of the individual fish showing gas bubble trauma was at the Level 1 rank.

Table 1. Summarization of days by year with total dissolved gas exceeding Idaho state water quality standard and the percentage of gas bubble trauma observed for all and selected fish species, excluding species suspected of being entrained through Dworshak Dam.

	1995	1996	1997	1998	1999
Days TDG exceeding 110%	33	41	55	47	41
Days TDG exceeding 120%	10	17	20	0	0
Number of individual fish examined	4,752	5,773	8,557	5,474	5,935
Number of fish species with GBT	5	2	7	1	2
% GBT for all species	0.2	0.2	0.8	<0.1	<0.1
%GBT for wild rainbow trout	0.0	2.0	7.5	0.0	0.4
%GBT for mountain whitefish	1.0	0.1	0.7	0.0	0.0
%GBT for largescale sucker	0.1*	0.2*	1.3	0.0	<0.1

*May include some bridgelip suckers

Table 2. Number of individual fish with gas bubble trauma by river section and year. Number in pararenthesis () indicate the number of fish suspected of entrainment through Dworshak Dam.

Section	1995	1996	1997	1998	1999
1	32(27)	11(1)	60(10)	1(1)	6(5)
2	2	6	28(7)	0	1
3	1	0	1	0	0
4	1	0	0	1	0
5	0	0	1	-	-
Total all sections	36(27)	17(1)	90(17)	2(1)	7(5)

Table 3. Number of individual wild rainbow trout with gas bubble trauma by river section and year, (number with GBT/number sampled).

Section	1995	1996	1997	1998	1999
1	0/119	3/56	4/45	0/45	1/99
2	0/35	0/10	1/8	0/17	0/6
3	0/11	0/3	0/4	0/33	0/20
4	0/28	0/31	0/1	0/49	0/17
5	0/37	0/71	0/8	-	-
Total all sections	0/230	3/147	5/66	0/144	1/142

Table 4. Number of individual mountain whitefish with gas bubble trauma by river section and year (number with GBT/number sampled).

Section	1995	1996	1997	1998	1999
1	3/297	0/347	12/334	0/101	0/85
2	1/67	2/682	7/855	0/265	0/327
3	1/156	0/618	0/1010	0/322	0/326
4	0/58	0/485	0/568	0/206	0/223
5	0/0	0/28	0/61	-	-
Total all sections	5/578	2/2006	19/2828	0/894	0/961

Table 5. Number of individual largescale sucker with gas bubble trauma by river section and year (number with GBT/number sampled).

Section	1995	1996	1997	1998	1999
1	0/280	0/426	18/488	0/127	0/263
2	0/209	4/439	8/417	0/368	1/270
3	0/229	0/409	1/394	0/419	0/421
4	1/252	0/496	0/454	0/396	0/452
5	0/139	0/494	1/477	-	-
Total all sections	1/1109	4/1903	28/2230	0/1310	1/1386

Table 6. Percentage of observed GBT (all species except entrained individuals) during individual sampling intervals and sections, 1995.

Interval	Dates	Maximum TDG	Section 1	Section 2	Section 3	Section 4	Section 5	All sections
1	4/17-23	110	-	-	-	-	-	-
2	4/24-30	120	-	1.7	-	-	-	0.8
3	5/1-7	120	-	0.8	-	-	-	0.5
4	5/8-14	120	-	-	-	-	-	-
5	5/15-21	110	8.3	-	-	-	-	1.3
6	5/22-28	104	-	-	-	-	-	-
7	5/29-6/4	110	-	-	-	-	-	-
8	6/5-11	105	-	-	-	-	-	-
9	6/12-18	112	1.7	-	1.3	0.8	-	0.6
10	6/19-25	115	-	-	-	-	-	-
11	6/26-7/2	110	-	-	-	-	-	-
12	7/3-9	112	-	-	-	-	-	-
13	7/10-16	112	-	-	-	-	-	-
14	7/17-23	111	-	-	-	-	-	-
15	7/24-30	111	3.7	-	-	-	-	0.6
16	7/31-8/6	111	-	-	-	-	-	-
17	8/7-13	110	-	-	-	-	-	-
18	8/14-20	111	-	-	-	-	-	-

Table 7. Percentage of observed GBT (all species except entrained individuals) during individual sampling intervals and sections, 1996.

Interval	Dates	Maximum TDG	Section 1	Section 2	Section 3	Section 4	Section 5	All sections
1	4/8-14	No Data	-	-	-	-	-	-
2	4/15-21	110	-	-	-	-	-	-
3	4/22-28	120	-	-	-	-	-	-
4	4/29-5/4	113	-	-	-	-	-	-
5	5/5-11	120	-	-	-	-	-	-
6	5/12-18	120	-	-	-	-	-	-
7	5/19-25	110	-	-	-	-	-	-
8	5/26-6/1	112	-	-	-	-	-	-
9	6/2-8	114	-	-	-	-	-	-
10	6/9-15	114	-	-	-	-	-	-
11	6/16-22	110	-	-	-	-	-	-
12	6/23-29	109	-	-	-	-	-	-
13	6/30-7/6	106	-	-	-	-	-	-
14	7/7-13	106	-	-	-	-	-	-
15	7/14-20	108	-	-	-	-	-	-
16	7/21-26	105	-	-	-	-	-	-
17	7/27-8/2	105	-	-	-	-	-	-
18	8/3-9	109	-	-	-	-	-	-
19	8/10-16	122	-	-	-	-	-	-
20	8/17-23	122	4.5	-	-	-	-	1.6
21	8/24-30	120	10.4	12.2	-	-	-	12.1

Table 8. Percentage of observed GBT (all species except entrained individuals) during individual sampling intervals and sections, 1997.

Interval	Dates	Maximum TDG	Section 1	Section 2	Section 3	Section 4	Section 5	All sections
1	4/20-26	122	-	-	-	-	-	-
2	4/27-5/3	122	4.8	4.3	-	-	-	2.4
3	5/4-10	122	14.5	0.8	-	-	-	3.7
4	5/11-17	120	5.6	-	-	-	0.9	1.4
5	5/18-24	109	-	-	-	-	-	-
6	5/25-31	107	-	-	-	-	-	-
7	6/1-7	108	-	-	-	-	-	-
8	6/8-14	106	-	-	-	-	-	-
9	6/15-21	113	-	-	-	-	-	-
10	6/22-28	119	-	-	-	-	-	-
11	6/29-7/5	110	-	-	-	-	-	-
12	7/6-12	110	-	-	-	-	-	-
13	7/13-19	118	-	-	-	-	-	-
14	7/20-26	118	3.3	-	-	-	-	0.6
15	7/27-8/2	118	-	-	-	-	-	-
16	8/3-8/9	120	5.0	8.1	-	-	-	2.5
17	8/10-16	119	14.4	6.5	1.0	-	-	3.5
18	8/17-23	110	1.0	2.0	-	-	-	0.6
19	8/24-30	110	-	-	-	-	-	-

Table 9. Percentage of observed GBT (all species except entrained individuals) during individual sampling intervals and sections, 1998.

Interval	Dates	Maximum TDG	Section 1	Section 2	Section 3	Section 4	Section 5	All sections
1	4/26-5/2	112	-	-	-	-	-	-
2	5/3-9	113	-	-	-	-	-	-
3	5/10-16	118	-	-	-	-	-	-
4	5/17-23	111	-	-	-	-	-	-
5	5/24-30	111	-	-	-	-	-	-
6	6/1-7	110	-	-	-	-	-	-
7	6/8-14	105	-	-	-	-	-	-
8	6/15-21	111	-	-	-	-	-	-
9	6/22-28	107	-	-	-	-	-	-
10	6/29-7/4	106	-	-	-	-	-	-
11	7/5-11	111	-	-	-	-	-	-
12	7/12-18	113	-	-	-	-	-	-
13	7/19-25	119	-	-	-	-	-	-
14	7/26-8/1	118	-	-	-	-	-	-
15	8/2-8	114	-	-	-	-	-	-
16	8/9-15	112	-	-	-	-	-	-
17	8/16-22	111	-	-	-	-	-	-

Table 10. Percentage of observed GBT (all species except entrained individuals) during individual Sampling intervals and sections, 1999.

Interval	Dates	Maximum TDG	Section 1	Section 2	Section 3	Section 4	Section 5	All sections
1	4/18-24	109	-	-	-	-	-	-
2	4/25-5/1	110	-	-	-	-	-	-
3	5/2-8	110	-	-	-	-	-	-
4	5/9-15	109	-	-	-	-	-	-
5	5/16-22	113	-	-	-	-	-	-
6	5/23-29	113	-	-	-	-	-	-
7	5/30-6/5	109	-	-	-	-	-	-
8	6/6-12	110	-	-	-	-	-	-
9	6/13-19	110	-	-	-	-	-	-
10	6/20-26	111	-	-	-	-	-	-
11	6/27-7/3	111	-	-	-	-	-	-
12	7/4-10	111	-	-	-	-	-	-
13	7/11-17	108	-	-	-	-	-	-
14	7/18-24	112	-	-	-	-	-	-
15	7/25-31	111						
16	8/1-7	118	-	-	-	-	-	-
17	8/8-14	117	3.4	1.1	-	-	-	-
18	8/15-21	108	-	-	-	-	-	-

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